

DSN Research and Technology Support

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The activities of the Development Support Group in operating and maintaining the Venus Station (DSS 13) are discussed and progress noted. Activities covered include planetary radar, sky survey, Faraday rotation data collection, dual uplink carrier testing, X-band planetary radar developmental testing, Block IV receiver/exciter installation, equipping the 9-m antenna with a receive capability, and retrofitting the 26-m antenna with a functional planetary radar feedcone.

Activities in support of the DSS 14 high-power transmitter are also noted as are clock synchronization transmissions and Pioneer 10 science support.

During the two-month period ending October 15, 1973, the Development Support Group had the following activities in its operation of the Venus Station (DSS 13).

I. In Support of Section 331

A. Planetary Radar

For a total of 48 hours DSS 13 supported the ranging of the planet Venus to gather data for use by the MVM⁷³ project. Pseudonoise (PN) code and code-timing pulses were supplied, via microwave link, to DSS 14 for use as a modulating signal for the 400-kW R&D transmitter. This transmitted signal, radiated by the 64-m antenna, illuminated the planet Venus; the reflected signal was also received by the 64-m antenna at DSS 14.

B. Station Monitor and Control (RTOP-68)

As part of the work being done under Research and Technology Operating Plan 68 (RTOP-68), the SDS-930 computer and the 26-m antenna were utilized to test a developmental conical scanning program destined to be used at DSS 14.

II. In Support of Section 333

A. Sky Survey

Using the noise adding radiometer (NAR) and the 26-m antenna in a fixed position (usually 180° az and 85-87° el), data are collected on total antenna system temperature as Earth's rotation sweeps the antenna beam across the sky.

This observing is done when the station is closed for normal operation; during this period a total of 64½ hours of data were collected.

B. Faraday Rotation

Normally two receivers (the Smythe and Stanford receivers) are used for Faraday rotation data collection with their outputs being recorded on punched paper tape and returned to JPL in Pasadena for processing. However, early in this period both receivers failed and were returned to JPL and Stanford Research Institute for repair. Due to the estimated cost it was decided not to repair the Smythe receiver; Stanford Research Institute delivered a new Faraday rotation receiver late in the reporting period. This receiver, along with a new antenna, was installed and aligned to receive signals from Applications Technology Satellite 1 (ATS-1). Although only one receiver is available, the system is functioning and recording data on tape and a chart recorder. These data are, and will be, used by the MVM73 project for correction of received doppler and range data from the spacecraft.

III. In Support of Section 335

A. Dual Uplink Carrier

Continuing with baseline testing to monitor long-term noise and intermodulation performance, 8½ hours of testing were performed before the system was made inoperative by the removal of the Cassegrain feed cone from the 26-m antenna.

B. X-Band Radar (400 kW)

A 400 kW X-band Planetary Radar system is being developed using two klystrons whose outputs are combined. During this reporting period, the "test bed" at DSS 13 was modified to accept the X-band klystrons for acceptance-type testing. One klystron has been installed into the modified test bed, and element voltages have been applied, but no radio frequency testing has been accomplished.

Various other elements of the system have been integrated, a trial layout of the feed cone has been completed, and a technical requirements document (TRD) and request for bids (RFB) have been sent out for the driver of these klystrons.

C. Block IV Receiver/Exciter

In anticipation of providing extensive support during and after installation of the Block IV Receiver/Exciter

(RE) into DSS 14, four personnel from the group participated in final testing and trouble shooting at JPL in Pasadena during the last two weeks prior to shipment to Goldstone.

These same people have heavily supported the installation by fabricating and installing bracketry, terminating and installing coaxial cables, and aiding in preliminary checkout, all on a schedule determined by time available at DSS 14, usually during the midnight and weekend hours. At the end of this reporting period, the permanent cables between the DSS 14 Control Room and the tricone support structure on the 64-m antenna, which are to be manufactured and installed by the DSS 14 personnel, are not yet installed. All other cables are connected, and temporary cables are installed to allow preliminary testing to continue.

D. 9-m Antenna Receive Capability

Using available equipment wherever possible, the 9-m antenna was equipped with a capability to receive at frequencies between 8400 and 8500 MHz. The converter used on the 8448-MHz radar system of several years ago was slightly modified to handle the wider frequency range, and was installed. The standard station receiver, which operates at 30 MHz, was used to complete the system. The feed horn with which the 9-m antenna was already equipped is used at 7150 MHz, even though it is not optimum for this frequency range, but it was decided not to change feed horns since to do so would disable the capability of the 9-m antenna to transmit clock synchronization.

Due primarily to the nonoptimum feed horn, the gain of the antenna at this frequency (8450 MHz) was measured to be approximately 53.1 dB, an efficiency of only 31%. This also contributed to the overall system temperature that was measured to be approximately 2810-K single sideband.

E. 26-m Antenna Feed Cone Retrofit

Early in this reporting period, the special noise burst (NBS) feed cone, which was used for dual carrier testing, was removed from the 26-m antenna and the feed horn from this cone was returned to Section 333 for use in building a special low noise cone for DSS 43. Prior to replacing the NBS cone with the S-band radar operational (SRO) cone that had been previously used on this antenna, we decided to weld all exterior seams and perform the same "noise proofing" operations on it as had been done on the NBS cone. After completion of "noise proofing" and

repainting, the SRO cone was reinstalled on the 26-m antenna, and the maser, from which the comb section had been removed, was also reinstalled (a slightly worse-performing comb section was installed). Just prior to the end of the period, the 26-m antenna was again made operational for reception at S-band with a zenith look system temperature of approximately 29 K.

F. Microwave Test Facility Machine Shop Relocation

Since activities at the Microwave Test Facility (MTF) had been severely curtailed (Ref. 1), we decided to relocate the machine shop to DSS 13. This machine shop, consisting of a vertical mill, horizontal mill, lathe, drill presses, and belt sanders, is used for fabrication of waveguide components, developmental structural parts, and prototype fabrication. It has now been reinstalled at DSS 13 and is fully operational.

IV. In Support of Section 422

A. Clock Synchronization Transmissions

Scheduled clock synchronization transmissions have been suspended since September 1972 for lack of need by flight projects. However, the impending launch of MVM73 has made it desirable that these scheduled transmissions be resumed. Although the system had been regularly tested, it was gone over thoroughly to ensure its readiness. These tests were completed by the beginning of September, but DSN Scheduling has not yet scheduled regular transmissions to the overseas stations. However, DSS 42 requested and received some special transmissions for a total of three hours.

B. DSS 14 High Power Transmitter Maintenance

The developmental frequency 400-kW transmitter at DSS 14 has been plagued by "kick-offs" due to higher than allowable reflected radio frequency power. Intensive testing could not isolate any one component that was the cause, although the feed cone as a whole was marginal, particularly after a period of operation at high power. It was finally concluded that the most likely cause of the difficulty was work-hardened inclusions in the wall of the waveguide which, under thermal cycling, had raised up from the walls and represented a point of localized high-voltage RF fields. These concentrated fields initiated arcing and caused the reflected RF power to become unacceptably high.

The protective circuits on the transmitter were set at higher than normal levels and an effort was made to "burn out" these suspected trouble spots by sustained high-power operation. After eight hours of high-power operation, this approach was apparently successful. After several initial kick-offs, the reflected power decreased and stabilized at an acceptable value. Some five hours of trouble-free operation were achieved at the 400-kW power level and, tentatively, the problem is assumed to be solved.

V. In Support of Section 825

Although, as mentioned earlier, the 26-m antenna's receiving capability was disabled early in this period, a total of 38½ hours of reception of the radiation from Jupiter and various radio-star calibrators was achieved. These data will be used as a comparison for the data to be telemetered back by Pioneers 10 and 11 when they encounter Jupiter.

Reference

1. Jackson, E. B., "DSN Research and Technology Support," in *The Deep Space Network Progress Report*, Technical Report 32-1526, Vol. XVI, pp. 102-104. Jet Propulsion Laboratory, Pasadena, Calif., Aug. 15, 1973.